## REMARKS

In response to the office action of 11-11-2006 the following items are addressed regarding the claims:

1. Examiner rejects claim 15. Examiner states that claim 15 fails to further limit the subject matter of claim 1, that the limitation of claim 15, that the enhanced Compton gamma camera operate as an enhanced edge-on gamma camera, is stated in claim 1. Applicants have canceled claim 15.

2. Examiner rejects claim 21. Examiner states that there is insufficient antecedent basis for the limitations "the spatial and energy resolution", the relative signal strength", "the aperture height". Applicants respond that all of these limitations are specified for edge-on scintillator detector implementations with electronically-determined interaction height measurement capability. Consider the edge-on scintillator detector implementation (page 41, lines 1-16). On page 41, lines 1-4 Applicants describe that the benefits of sub-aperture resolution including "increased spatial resolution, signal loss compensation" that are possible with edge-on semiconductor detectors can be attained with edge-on scintillator detectors. Note that the goal of "signal loss compensation" is to improve energy resolution (page 11, lines 15-17). On page 41, lines 11-15 Applicants describe analyzing "the relative signal strength" measured and calibrating the "relative signal strength" versus interaction location in the direction of the "aperture height (interaction height)". Thus "aperture height" is equated with "interaction height" by the Applicants.

3. Examiner rejects claim 13. Examiner cites Figure 1 as evidence for a coarse collimator that does not provide enablement for a coarse collimator covering alternate edge-on detectors but rather covers all edge-on detectors. Applicants respond that the collimator shown in Figure 1 is not a coarse collimator but a standard collimator design used in gamma camera imaging where each collimator hole defines an image pixel. Applicants cite Figure 11c and the description provided on page 49, lines 1-13: "Although the benefit associated with the elimination of conventional collimators in Compton scatter imaging is substantial, the use of limited collimation may be of value if substantial reconstruction errors or dead time are likely to occur due to the energy levels of the incident photons and the range of incident photon angles at the edge-on Compton gamma camera. As shown in FIG. 11c, an optional radiation shield 117 is placed above each edge-on detector 115 of material 1 that is not shadowed by an edge-on detector 116 of material 2 in order to limit direct exposure from the radiation source. In this instance elevating certain detectors in the array improves the overall Compton scatter efficiency. (This optional radiation shield can be implemented in the same alternating format even if all edge-on detectors in the detector array are composed from the same material.) This optional shield functions as a coarse collimator and in this instance we refer to this coarse collimator as a particular implementation of a course Compton collimator."

4. Examiner rejects claim 1. Examiner cites non-statutory obviousness-type double patenting over claim 1 of U.S. Patent No. 6,583,420 B1 (Nelson) in view of Gerstenmayer (WO 00/63723). Examiner cites that all of the limitations of claim 1 are disclosed in claim 1 of U.S. Patent No. 6,583,420 B1 except that the edge-on detector measures electronically determined interaction height. Examiner cites that electronically determined interaction height is known, as disclosed by Gerstenmayer (Figure 2, the interaction height is detected). Applicants respond that Figure 2 of Gerstenmayer (as well as the text of his patent) does not demonstrate sub-aperture resolution or equivalently "interaction height" information (as defined by the inventors). Applicants cite the U.S. Patent 6,727,503 B1 (April 27, 2004) issued to Gerstenmayer herein. Gerstenmayer (page 4, lines 45-60) describes an x-ray that interacts with the material of sheet 4 to produce a high kinetic energy electron with a trajectory 18. (Of course, electrons can be ejected in almost all directions so trajectory 18 is not unique.) Arrow 20 shows the trajectory of a photon (either Compton scattered or a characteristic x-ray since it is of lower energy than the incident x-ray) which may interact somewhere within the sheet 4, the semiconductor 6, or it may escape the volume. The readout tracks 22 are used to collect charge carriers (electrons or holes) generated in layers 6 (the semiconductor material) by the electrons produced by x-rays interacting with the conducting material of sheets 4. Each group of tracks 22 is associated with one of the layers 6 and is in contact with it. Each of the layers 6 is associated with one of the sheets 4. Thus one group of tracks 22 (the parallel readout strips) is associated with one sheet 4. Clearly this design cannot be used to electronically-determine the interaction height of an x-ray event since there is only a single-sided parallel strip readout. With Gerstenmayer's detector design this would not be possible anyway! Gerstenmayer design collects a hot electron from an event due to an x-ray interaction within sheet 4 at a single readout track 22 in layer 6. Unfortunately there is no way to tell how far away from a track 22 the hot electron was when it was liberated nor its initial direction or energy. (There are no electrons and holes to migrate to an anode and cathode, respectively, and thus provide 1-D information along the thickness of the edge of the semiconductor material as described by the Applicants.) Furthermore, Gerstenmayer explicitly states (page 7, lines 32-35) that "the spatial resolution in the direction perpendicular to the sheets 4 is determined by the pitch between the sheets 4 and between the tracks (that may be of the order of 50 um to 200 um)." Gerstenmayer says, in effect, that his spatial resolution in the direction perpendicular to the sheet (its edge thickness) is fixed by its physical dimension. There is no physical possibility of electronically-determining the interaction height of x-rays in the Gerstenmayer patent. There is no dual-readout capability. Applicants cite that on page 10, lines 4-19 of the pending Application the thickness of the edge (the entrance aperture) is defined as the "height", the length or width define the attenuation length. The "interaction height" is defined as the interaction position of a radiation event along the height of the edge-on detector aperture. The interaction depth is defined for face-on irradiation by the inventors. The passage on page 10, lines 4-19 is included herein: "Consider a scenario in which radiation is incident upon a planar edge-on detector. The detector thickness (height) now defines the maximum detector entrance aperture while the length or width of the detector area now defines the maximum attenuation distance for edge-on radiation detector designs including semiconductor drift chamber, single-sided strip, and double-sided strip detectors, including micro-strip detector versions. Strip widths can be tapered or curved,

in the case of drift chamber detectors, if focusing is desired. In the case of double-sided parallel strip detectors (in which opposing strips are parallel) or crossed strip or 2-D pixelated array detectors, both electrons and holes produced by a radiation event can be collected to provide 1-D positional information between the anode and the cathode sides of the aperture. This 1-D positional information is used to determine electronically the sub-aperture spatial resolution. The interaction position along the height of the edge-on detector aperture will be referred to as the interaction height. (When a scintillator, semiconductor, gas, or liquid detector is irradiated face-on the 1-D positional information along the thickness direction of the detector is referred to as the interaction depth.)."

5. Examiner rejects claim 1. Examiner cites that Gerstenmayer discloses an enhanced Compton gamma camera used in nuclear medicine with all the attributes of claim 1. Applicants reply that this is a physical impossibility. A Compton gamma camera has 3-D spatial resolution. The title of Gerstenmayer's patent is "Two Dimensional Ionizing Radiation Detector and Method for the Production Thereof". Nowhere within Gerstenmayer's patent does he discuss 3-D detection capability. Furthermore, in the previous paragraph the Applicants have already shown that Gerstenmayer's design is incapable of performing electronically-determined interaction height measurements. Gerstenmayer's 2-D detector design is not suitable as an enhanced Compton gamma camera or even a conventional Compton gamma camera.

6. Examiner rejects claim 3. Examiner cites that the detector modules include edge-on radiation detectors with different properties or materials. Applicants reply that Gerstenmayer's detector is a stack of sheets 4 of a first material intended to emit second particles (electrons) alternating with layers of semiconductor material 6 (to receive the electrons) and parallel conducting tracks 22 to the readout electronics. The sheets 4 can not function as detectors by themselves, their primary purpose is to efficiently stop the ionizing radiation and act as a source of energetic electrons for the semiconductor detector and readout. The use of such a converter material is well known in high energy radiation therapy imaging or neutron imaging. Applicants describe edge-on radiation detectors with different properties that independently function as detectors (Figure 11 of the application) and not simply individual edge-on radiation detector made from multiple materials (Gerstenmayer's design).

7. Examiner rejects claim 5. Examiner cites that Gerstenmayer discloses an edge-on radiation detector that is a dual sided parallel strip semiconductor detector (Figure 1). Applicants respond that Gerstenmayer's Figure 1 does not show a dual-sided parallel strip semiconductor detector as described by the Applicants (see Applicants' Figure 1 wherein the semiconductor detector volume is between the anode and cathode readout strips with the advantage that electronically-determined interaction height information between opposite pairs of strips can now be determined). Applicants have already noted that Gerstenmayer's description of his detector (page 4, lines 45-60) is that it has a single-sided parallel strip readout. The readout tracks 22 (parallel strips) are used to collect charge carriers (electrons or holes) generated in layers 6 (the semiconductor material) by the electrons produced by x-rays interacting with the conducting material of sheets 4. Each group of tracks 22 is associated with one of the layers 6 and is in contact

with it. Each of the layers 6 is associated with one of the sheets 4. Thus one group of tracks 22 (the parallel readout strips) is associated with one sheet 4. Clearly this design cannot be used to electronically-determine the interaction height of an x-ray event since there is only a single-side parallel strip readout.

8. Examiner rejects claim 7. Examiner cites that Gerstenmayer discloses that edge-on radiation detector is a dual sided 2-D pixelated array semiconductor detector (Figure 1, 2-D on the edge side). Applicants respond that Gerstenmayer's 2-D pixelated array cannot provide electronically-determined interaction height information and it is not a dual-sided, pixelated array semiconductor detector with an array of anodes and cathodes on opposite sides of the semiconductor volume. Applicants have explained in the previous paragraph that Gerstenmayer's detector is not even a dual-sided detector but rather a single-sided detector. As described in the text of the pending application, the dual-sided pixelated array semiconductor detector provides the same depth-of-interaction measurement capability and electronically-determined interaction height measurement capability as the dual-sided crossed strip semiconductor detector of claim 6 and higher readout speeds (page 10, lines 10-15; page 11, line 23 through page 12, line 13).

9. Examiner rejects claim 10. Examiner contends that it is inherent that the detectors are moveable so that they can be properly positioned. Applicants respond that Gerstenmayer describes a 2-D detector which is incapable of functioning as a 3-D detector, including a 3-D Compton gamma camera. What possible reason would Gerstenmayer have for rotating or elevating or tilting individual detector elements (as seen in Figures 11c-d of the pending application), for example, when his 2-D resolution is constrained to imaging ionizing radiation from largely one direction (parallel to the readout tracks (readout strips))? Gerstenmayer's detector has no need for such dynamic capabilities that can alter the geometry of its detector elements relative to each other so as to enhance the detection of radiation that is Compton-scattered by the detector itself. These features only benefit a Compton gamma camaera.The only positioning capability Gerstenmayer's 2-D detector requires is to have its readout strips aligned approximately parallel to the incident x-ray radiation, just as one would do with any other 2-D detector.

10. Examiner rejects claim 15. Examiner cites that Gerstenmayer discloses that the camera operates as an edge-on gamma camera (Column 1, lines 10-11). Applicants reply that claim 15 defines an enhanced (electronically-determined interaction height measurement capability) edge-on gamma camera which applicants have established that Gerstenmayer both does not describe and could not be implemented with his design. Furthermore, Gerstemayer indicates that the invention can be used to detect gamma rays. Any x-ray detector can be used to detect gamma rays. Gamma rays are stilled used for radiation therapy treatment in some hospitals. Gerstenmayer does not mention nuclear medicine applications because his converter layer offers poor energy resolution (needed for nuclear medicine to rejected scattered gamma x-rays that have lost a significant fraction of their original energy). The small fraction of hot electrons that escape from a converter sheet and reach the semiconductor layer will continuously lose energy along their paths. So the final energy that a hot electron deposits for readout is likely to be much less than original hot electron energy, depending upon its path. Many hot electrons

will simply be reabsorbed within the converter sheet (resulting in wasted radiation to the patient being imaged in nuclear medicine, highly undesirable).

11. Examiner rejects claim 16. Examiner cites that Gerstenmayer discloses that the camera operates as an enhanced edge-on PET camera (Column 1, lines 17). Applicants respond using the same arguments as used for claim 1 and claim 15. No "enhanced" (electronically-determined interaction height measurement ) capability, inherent poor energy resolution and wasteful of radiation (unsuitable for PET), a 2-D detector (undesirable for current PET detectors). Furthermore, Column 1, line 17 of Gerstenmayer's patent does not describe a PET camera but rather "position of patients in radiotherapy".

12. Examiner rejects claim 18. Examiner correctly cites that Gerstenmayer's detector is used for radiographic imaging (Column 1, line 19). Applicants respond that Gerstenmayer does not provide an "enhanced" radiographic imaging capability by providing electronically-determined interaction height measurements.

13. Examiner rejects claim 19. Examiner correctly cites that Gerstenmayer's detector is used for radiographic imaging and therefore could be used for radiographic CT (Column 1, line 19). Applicants respond that Gerstenmayer does not provide an "enhanced" radiographic CT imaging capability by providing electronically-determined interaction height measurements.

14. Examiner rejects claim 20. Examiner cites Gerstenmayer as disclosing that the camera is irradiated from the side such that the incident radiation is parallel to the plane of the edge of the detector array as shown in Figure 1. Applicants respond that their definition of side irradiation (page 52, lines 1-23 and page 53, lines 1-5) is different from that of the examiner. Specifically, consider page 52, lines 1-8: "Although FIG. 1 and FIG. 11 show radiation incident approximately perpendicular to the plane of the edge-on detector array it should be noted that irradiation from the left or right side (approximately parallel to the plane) of the edge-on detector array is allowed. Thus an edge-on (or enhanced edge-on) Compton camera, SPECT camera, or PET camera can be irradiated from the side. The side-irradiation geometry may be useful for specific applications. For example, it may be desirable to collimate the radiation so that the detector region near the base and relevant readout electronics are removed from direct irradiation." Figure 1 of the pending application shows the incident radiation from the top is perpendicular to the top planar surface of the edge-on detector array that is mounted on a base (plane) with readout electronics. This base plane is parallel to the top planar surface and thus also perpendicular to incident radiation (and therefore in the direct path of any radiation that is transmitted through the edge-on detectors, which may be undesirable). If radiation from the right or left side is parallel to the plane of the edge-on detector array of Figure 1 such that base plane and readout electronics escape direct irradiation then the plane referred to must be parallel to the base plane and readout electronics. Hence this defines the geometry for side irradiation, parallel to the base plane and readout electronics. It is clear from Gerstenmayer's Figure 1 that the incident radiation is incident perpendicular to the mounting base with readout electronics 30. This is exactly the same detector irradiation

format as shown in the Applicant's Figure 1 and thus can not describe side irradiation as defined by the Applicants.

15. Examiner rejects claim 2. Examiner cites claim 2 as being unpatentable over Gerstenmayer (WO 00/63723) in view of Kobayashi (US Patent 4,201,805). Examiner states that Gerstenmayer disclosed the limitation of claim 1 but did not specify that detection modules also included face-on detectors but Kobayashi discloses a combination of face-on and edge-on detectors (Figure 1). Examiner states that the combination of Kobayashi and Gerstenmayer inventions is obvious in order to increase the field of view of the detector. Applicants respond that they have already demonstrated that Gerstenmayer does not disclose the limitation of Applicants' claim 1. Furthermore Examiner is mistaken in that Kobayashi in his Figure 1 shows a single detector being irradiated face-on and edge-on, it is not a combination of a face-on detector and an edge-on detector. Hence Kobayashi does not show separate face-on and an edge-on detectors being used for Compton scatter imaging as described by the Applicants. Applicants' claim 2 specifies the inclusion of a separate face-on detector. (A face-on detector to initiate Compton scattering of x-rays and a separate edge-on detector to detect the Compton scattered x-rays.) This can be seen in Figure 8 (page 37, lines 11-15) and specifically in Figure 11b (page 46, lines 6-15) of the pending application. Furthermore the separate face-on detector has electronically-determined interaction depth measurement capability. Neither Gerstenmayer nor Kobayashi describe such a feature which can extend depth spatial resolution and permit energy corrections.

16. Examiner rejects claim 6. Examiner cites claim 6 as being unpatentable over Kobayashi (US Patent 4,201,805) who discloses that the edge-on detector is a dual-sided cross strip semiconductor detector (Figure 1). Applicants respond that Examiner is mistaken in that Kobayashi's Figure 1 shows a simple 1-D detector that is single sided (meaning that readout capability is limited to one side, the other side is grounded as shown in the figure). There is no crossed strip configuration. The function of the crossed strips is to provide 2-D resolution (Figure 11a). Dual-sided implies that the sets of strips are on opposite sides of the detector plane and both sets of strips are used to readout signals (holes and electrons). Furthermore, the electronically-determined interaction height information measurement capability of Applicants' detector is not described by Kobayashi.

17. Examiner rejects claim 8. Examiner cites claim 8 as being unpatentable over Gerstenmayer (WO 00/63723) in view of Nygren (US Patent 5,434,417). Examiner states that Gerstenmayer disclosed the limitation of claim 1. Examiner states that Nygren discloses a plurality of detector modules wherein the detectors are stacked to extend the attenuation length (column 3, line 67-column 4, line15). Applicants respond that they have already demonstrated that Gerstenmayer does not disclose the limitation of Applicants' claim 1. Applicants respond that Examiner is mistaken with regard to Nygren in that Nygren describes a segmented semiconductor strip detector (Figure 2). Nygren states (column 4, lines 1-4): "In the present embodiment segmentation of strip detector 20 is achieved by lithographic subdivision of a monolithic strip detector into four discrete segments". Thus a monolithic piece of silicon has monolithic strips that are segmented

lithographically into discrete segments. The monolithic piece of silicon is not physically cut into discrete pieces and then stacked one on top of another. The Nygren approach of segmenting the readout strips was described 5 years earlier by one of the Applicants (Nelson, U.S. Patent 4,937,453 (6-26-90): column 8, lines 28-32). What Nygren and Nelson have done is created a 2-D array from a 1-D strip array by dividing up the strips and forming the equivalent of rectangular "pixels". Applicants describe that the face-on detectors stacked on top of the edge-on detectors shown in Figure 11b can be turned on their sides and stacked edge-on to the edge-on detectors (page 46, lines 6-19). Thus a discrete array of edge-on detectors is physically stacked on top of another discrete array of edge-on detectors. Furthermore, these edge-on detectors can implement electronically-determined interaction height measurement capability, a feature not described by Nygren.

18. Examiner rejects claim 9. Examiner cites claim 9 as being unpatentable over Gerstenmayer (WO 00/63723). Examiner states that Gerstenmayer disclosed stacked detectors comprised of detector layers that use at least two different materials (his claim 6). Applicants note that Examiner has stated in the rejection of claim 8 that Gerstenmayer does not explicitly disclose that the detectors are stacked. Furthermore Gerstenmayer's claim 6 simply presents a list of materials from which the "semiconducting material is selected" (column 10, lines 4-9). A single semiconducting material encapsulates the metal strands or wires used to readout the signals. Furthermore, there is no obvious advantage in using two or more semiconductor encapsulating materials unless the readout mechanism could discriminate events "seen" by a first semiconductor material and events "seen" by a second semiconductor material positioned above or below (with respect to the radiation entrance surface) the first semiconductor material. But this "depth resolution" along the length of the readout strands or wires implies a 3-D detector, and Gerstenmayer's invention is strictly a 2-D detector. Furthermore, the Applicants' edge-on detectors can implement electronically-determined interaction height measurement capability.

19. Examiner rejects claim 12. Examiner cites claim 12 as being unpatentable over Gerstenmayer (WO 00/63723) in view of Nygren (US Patent 5,434,417). Examiner states that Gerstenmayer disclosed the limitation of claim 1. Examiner states that Nygren discloses using a collimator (Figure 5, element 66) to restrict radiation from a particular acceptance angle and furthermore he discloses that the collimator can be configured to be adapted to a number of configurations (column 8, lines 28-51). Therefore it was obvious to use the collimator as disclosed by Nygren with Gerstenmayer to reduce erroneous data (scattered radiation) from reaching the detector element and thus increasing the accuracy of the detected signal. Applicants respond that they have already demonstrated that Gerstenmayer does not disclose the limitation of Applicants' claim 1. Applicants note that x-ray collimation using slits or slots in order to limit scatter for edge-on detector array x-ray imaging was described 5 years earlier than Nygren by one of the Applicants (Nelson, U.S. Patent 4,937,453 (6-26-90): column 5, lines 16-22 with examples of slit collimators shown in Figures 4,5,6A).Applicants respond that Examiner is mistaken with regard to Nygren's x-ray collimator (or un-named configurations thereof) being useful for a Compton gamma camera. Nygren's Figure 5 demonstrates a double x-ray collimator with multiple slits arrangement that might be used for area x-ray imaging, as described by

Nygren. Nygren's double collimator consists of multiple slits (Column 5, lines 34-42), and each pair of aligned upper and lower slits are in turn aligned with a single segmented strip edge-on detector. The slit openings are typically very fine since spatial resolution needed in medical x-ray radiographic imaging can be as small as 50 um. The collimator slits are very efficient at reducing detected x-ray scatter but they waste (attenuate) a very large fraction of the x-ray tube output. This inefficient use of radiation by itself makes the slit collimators of Nygren and Nelson unattractive for use with a Compton gamma camera. Furthermore these slit collimators can not be considered to be coarse collimators since at least one slit dimension (the slit width) defines the corresponding pixel dimension (here the readout strips of the edge-on detectors represent the detector pixels). Slit collimators can be useful for x-ray imaging because the direction of the unscattered x-rays is assumed to be known. Off-axis x-rays are assumed to be scattered. Furthermore, the level of x-rays scattered along the length of the slit is assumed to be small (and the length dimension is significantly greater than the width dimension for most medical slit scanning applications). (Nuclear medicine imaging has the problem that the radiation sources within the body emit in all directions and so there is no preferred directional radiation beam as is used in x-ray radiography. Note that off-axis radiation emitted by an object carries useful information just as on-axis radiation does. Furthermore, the traditional collimators used with gamma cameras essentially define the limiting spatial resolution of the gamma camera plus collimator system in two dimensions, rather than being defined by the intrinsic spatial resolution of the gamma camera.) Thus, the conventional gamma camera collimator shown in Figure 1 of the present Application (which defines spatial resolution in two dimensions) is also not a coarse collimator. Contrary to the examiner's assertion, the coarse Compton collimator does not reduce scatter radiation from reaching the detector. Scatter is rejected electronically based on the total energy detected from an event by the Compton gamma camera. What the coarse Compton collimator does is limit the practical angular field of view of subsections of the camera. For example, one implementation of a coarse Compton collimator can be used to avoid detecting x-rays at extreme angles with respect to the Compton gamma camera that would be difficult to reconstruct or are likely to interact with only a small fraction of the total detector volume (and thus not depositing all of their energy). Another example is to use the coarse Compton collimator to shield specific detector modules so that they mainly see Compton scatter radiation rather than the direct radiation. Three types of coarse Compton collimators are described by the Applicants (page 49, lines 1-23 through page 50, lines 1-5): the radiation shield (Figure 11c), the static collimator with very large holes (a conventional gamma camera collimator but with very large holes), and a dynamic collimator (Figure 6). The spatial resolution of the Compton gamma camera system will still be largely determined by the inherent resolution of the detector itself since there are large open detector spaces, much larger than the dimensions of individual detector pixels of the enhanced Compton gamma camera . The detection efficiency will remain high relative to that of a conventional gamma camera collimator. Coarse Compton collimators would not be useful for x-ray imaging or with a conventional gamma camera. They are only effective for a Compton gamma camera.

20. Examiner rejects claim 13. Examiner cites claim 13 as being unpatentable over Gerstenmayer (WO 00/63723) in view of Nygren (US Patent 5,434,417). Examiner

states that Nygren discloses a coarse Compton collimator (Figure 5, element 66) wherein a radiation shield covers alternate edge-on detectors in order to limit their direct exposure from the radiation source. Nygren discloses that the collimator can be configured to be adapted to a number of configurations (Column 8, lines 28-51). Applicants respond that they have already demonstrated that Gerstenmayer does not disclose the limitation of Applicants' claim 1, the ability to electronically-determine interaction height. Applicants respond that Examiner is mistaken with regard to Nygren's x-ray collimator (or un-named configurations thereof). Nygren's multi-slit collimator clearly does not cover alternate edge-on detectors to shield them from direct exposure as can be seen in Nygren's Figure 5 and Nygren's description of his double collimator that consists of multiple slits (Column 5, lines 34-42). Each pair of aligned upper and lower slits are in turn aligned with a single segmented strip edge-on detector. Not only does Nygren not shield alternate edge-on detectors from direct radiation, it would be pointless to implement such a design for a radiographic x-ray imaging scanner. (Why not simply leave the "shielded" edge-on detectors out of the scanner entirely and save a substantial amount of money?) Applicants note that the collimator shown in Figure 1 of the pending application is not a coarse collimator used to shield alternate edge-on detectors but rather a standard collimator design for gamma camera imaging wherein each collimator hole defines an image pixel. Applicants cite Figure 11c and the description provided on page 49, lines 1-13 of the pending application: "Although the benefit associated with the elimination of conventional collimators in Compton scatter imaging is substantial, the use of limited collimation may be of value if substantial reconstruction errors or dead time are likely to occur due to the energy levels of the incident photons and the range of incident photon angles at the edge-on Compton gamma camera. As shown in FIG. 11c, an optional radiation shield 117 is placed above each edge-on detector 115 of material 1 that is not shadowed by an edge-on detector 116 of material 2 in order to limit direct exposure from the radiation source. In this instance elevating certain detectors in the array improves the overall Compton scatter efficiency. (This optional radiation shield can be implemented in the same alternating format even if all edge-on detectors in the detector array are composed from the same material.) This optional shield functions as a coarse collimator and in this instance we refer to this coarse collimator as a particular implementation of a course Compton collimator." This coarse Compton collimator would be of no value for x-ray imaging or conventional gamma camera imaging in nuclear medicine. It is only effective for use with a Compton gamma camera.

21. Examiner rejects claim 21. Examiner cites claim 21 as being unpatentable over Gerstenmayer (WO 00/63723) in view of McCroskey (US Patent 5,751,000 A). Examiner cites Gerstenmayer's Figure 1 and states that the relative signal strength or intensity (Column 4, line 66) versus interaction location in the direction of the aperture height or position (column 4, line 67) is measured. Examiner cites McCroskey and states that calibration tables and application of those tables during image acquisition are disclosed (column 9, lines 55-65). Applicants respond that the "position" Gerstenmayer refers to is in fact defined by the 2-D position information of the detector array (a particular readout track (strip) 22 associated with a specific sheet 4 and layer 6. Applicants have shown in their justification of pending claim 1 that Gerstenmayer does not demonstrate electronically-determined interaction height capability information (as

defined by the inventors). Gerstenmayer (page 4, lines 45-60) describes an x-ray that interacts with the material of sheet 4 to produce a high kinetic energy electron with a trajectory 18. (Of course, electrons can be ejected in almost all directions so trajectory 18 is not unique.) Arrow 20 shows the trajectory of a photon (either Compton scattered or a characteristic x-ray since it is of lower energy than the incident x-ray) which may interact somewhere within the general detector volume or may not interact at all. The readout tracks 22 are used to collect the electrons and each group of tracks is associated with one of the layers 6 and is in contact with it. Since Gerstenmayer collects a hot electron from an event at a single readout track in layer 6 there is no way to tell how far away from the track the hot electron was when it was liberated (there are no electrons and holes to migrate to an anode and cathode, respectively, and thus provide 1-D information along the thickness of the edge). Furthermore, Gerstenmayer explicitly states (page 7, lines 32-35) that "the spatial resolution in the direction perpendicular to the sheets 4 is determined by the pitch between the sheets 4 and between the tracks (that may be of the order of 50 um to 200 um)." Gerstenmayer says, in effect, that his spatial resolution in the direction perpendicular to the sheet (its thickness) is fixed by its physical dimension. There is no physical possibility of electronically-determining the interaction height in the Gerstenmayer patent. Applicants respond that the calibration look up table referred to by McCroskey (column 9, lines 60-61) is the same calibration table used by all manufacturers of gamma cameras that are based on a face-on, monolithic scintillator crystal with multiple PMT (photomultiplier tube) readout (column 6, lines 18-43). This industry-standard calibration process provides 2-D (x-y) information over a large fraction of the entrance surface of the face-on scintillator crystal. Applicants' edge-on detector array is inherently a 2-D detector or 3-D detector. Applicants' calibration method provides improved resolution along one dimension only (along the length of the aperture), energy correction, and a further benefit is the reduction in the total number of edge-on detector pieces needed to form a detector array of fixed surface area (cost savings). In some cases the improved spatial resolution possible with electronically-determined aperture height resolution may be unattainable by thinning the detector material aperture height to an equivalent thickness (there can be structural integrity issues or processing issues such as the inherent thickness of surface dead layers when the detector thickness is very small). Thus there are unique benefits associated with an aperture height calibration table for edge-on detectors not present in the calibration table approach appropriate for McCroskey's face-on scintillation gamma camera design.

22. Examiner rejects claim 24. Examiner cites claim 24 as being unpatentable over Gerstenmayer (WO 00/63723). Examiner states that Gerstenmayer discloses that the edge-on radiation detector is at least one of a dual readout scintillator (Figure 1). Applicants respond that Gerstenmayer's Figure 1 does not show either a dual-sided parallel strip semiconductor detector or a dual readout scintillator detector as described by the Applicants. YYY Gerstenmayer (page 4, lines 45-60) describes an x-ray that interacts with the material of sheet 4 to produce a high kinetic energy electron with a trajectory 18. Arrow 20 shows the trajectory of a photon (either Compton scattered or a characteristic x-ray since it is of lower energy than the incident x-ray) which may interact somewhere within the sheet 4, the semiconductor layer 6, or it may escape the volume. The readout tracks 22 are used to collect charge carriers (electrons or holes) generated in

layers 6 (the semiconductor material) by the electrons produced by x-rays interacting with the conducting material of sheets 4. Each group of tracks 22 is associated with one of the layers 6 and is in contact with it. Each of the layers 6 is associated with one of the sheets 4. Thus one group of tracks 22 (the parallel readout strips) is associated with one sheet 4. Clearly this design cannot be used to electronically-determine the interaction height of an x-ray event since there is only a single-sided parallel strip readout. Gerstenmayer explicitly states (page 7, lines 32-35) that "the spatial resolution in the direction perpendicular to the sheets 4 is determined by the pitch between the sheets 4 and between the tracks (that may be of the order of 50 um to 200 um)." Gerstenmayer says, in effect, that his spatial resolution in the direction perpendicular to the sheet (its thickness) is fixed by its physical dimension. There is no physical possibility of electronically-determining the interaction height in the Gerstenmayer patent either by electron-hole measurement (for semiconductors) or optical signal measurements (for scintillators). There is no dual-readout capability. Gerstenmayer shows an alternating pattern of layers comprised of semiconductor-encapsulated metallic readout strips between a stack of sheets 4 (the converter material that is the source of electrons). The converter material is a source of electrons and not optical photons. Furthermore Gerstenmayer has specified that his semiconductor material is used to detect the liberated electrons and possibly ionizing x-rays (column 4, lines 22-65), but not optical scintillation photons. Furthermore the paths of optical scintillation photons would not be influenced by the electric fields used to collect electrons to the semiconductor-encapsulated metallic readout strips. Applicants describe many edge-on scintillation detector designs, including dual-readout, that can provide electronically-determined interaction height position information (Page 41, line 17 through page 43, line 9).

## CONCLUSION

Applicants respectfully submit that the arguments presented overcome the Examiner's objections. Applicants invite the Examiner to telephone the undersigned representative if a telephonic interview would help advance this case to allowance.

Respectfully submitted,

By: Robert Sigurd Nelson Dated: 1-12-2007

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